IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:
SUN et al.

Serial No.: 10/611,805

Confirmation No.: 5060

Filed: June 30, 2003

For: AN EFFECTIVE METHOD TO IMPROVE SURFACE FINISH IN ELECTROCHEMICALLY ASSISTED CMP

§

Group Art Unit: 1742

Examiner: Michael P. Alexander

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Commissioner for Patents
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September 11, 2006
Date

Steven H VerSteeg

Dear Sir:

APPEAL BRIEF

Appellants submit this Appeal Brief to the Board of Patent Appeals and Interferences on appeal from the decision of the Examiner of Group Art Unit 1742 dated February 10, 2006, finally rejecting claims 1, 2, and 5-19. The final rejection of claims 1, 2, and 5-19 is appealed. This Appeal Brief is believed to be timely since mailed by the due date of September 10, 2006, as set by mailing a Notice of Appeal on July 10, 2006. Authorization to charge the fee of $500.00 for filing this brief is provided on a separate fee transmittal. Please charge any additional fees that may be required to make this Appeal Brief timely and acceptable to Deposit Account No. 20-0782/006877/KMT.

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Real Party in Interest

The present application has been assigned to Applied Materials, Inc., 3050 Bowers Avenue, Santa Clara, California 95054.

Related Appeals and Interferences

Appellants assert that no other appeals or interferences are known to the Appellants, the Appellants' legal representative, or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

Status of Claims

Claims 1, 2, and 5-19 are pending in the application. Claims 1-19 were originally presented in the application. Claims 1-19 were rejected in an Office Action mailed July 12, 2005. Claims 1-9, 11-14, and 16-19 were amended in a Response to Office Action filed October 12, 2005. A Notice of Non-Compliant Amendment was mailed November 7, 2006. A Response to the Notice of Non-Compliant Amendment was filed December 7, 2005 in which claims 1-9, 11-14, and 16-19 were amended in compliance with applicable rules. A Final Office Action was mailed February 10, 2006 rejecting claims 1-19. A first Response to Final Office Action was filed May 10, 2006 with amendments to claims 1, 5, and 18 and canceling claims 3 and 4. An Advisory Action was mailed June 5, 2006 indicating that the response filed May 10, 2006 was not entered. A second Response to Final Office Action was filed June 9, 2006 with amendments to claim 1 and canceling claims 3 and 4. In an Advisory Action mailed July 6, 2006, the Examiner indicated that the second Response to Final Office Action, which was filed June 9, 2006, would be entered. Claims 3 and 4 have been canceled without prejudice. Claims 1, 2, and 5-19 stand finally rejected as discussed below. The final rejection of claims 1, 2, and 5-19 is appealed. The pending claims are shown in the attached Claims Appendix.

Status of Amendments

The claim amendments presented after final rejection in the response filed June 9, 2006 have been entered by the Examiner and are reflected by the listing of claims included in the Claims Appendix.

Summary of Claimed Subject Matter

Claimed embodiments of the invention provide a method of electrochemically and mechanically planarizing a surface of a substrate (p. 5, paragraph [0014], lines 1-2).

In the embodiments of independent claim 1, a method of electrochemically and mechanically planarizing a surface of a substrate (p. 5, paragraph [0014], lines 1-2) is provided. The method comprises (a) providing an electrically conductive solution and an electrode in contact with the electrically conductive solution (p. 8, paragraph [0032], lines 1-4; Figure 1, items 120 and 104); (b) disposing a polishing medium in contact with the electrically conductive solution (p. 8, paragraph [0032], lines 1-4; Figure 1, item 105); (c) positioning the substrate having a conductive material formed thereon (p. 8, paragraph [0032], lines 4-7) against the polishing medium so that the surface of the substrate contacts the electrically conductive solution and the polishing medium (p. 13, paragraph [0050], lines 1-3; Figure 1, item 113); (d) applying a first positive potential between the polishing medium and the electrode for a first time period to remove conductive material from the substrate, wherein the first positive potential is a pulsed potential with a waveform (p. 20, paragraph [0067], lines 1-3 and 11-15; Figure 14); and (e) applying a second positive potential between the polishing medium and the electrode for a second time period to remove conductive material from the substrate, wherein the second potential is lower than the first potential (p. 20, paragraph [0067], lines 11-15; Figure 14).

Grounds of Rejection to be Reviewed on Appeal

1. Claims 1, 2, 5-9, 11-13, and 15-18 stand rejected under 35 U.S.C. § 102(b) as being unpatentable over United States Patent No. 5,911,619 to *Uzoh et al.*

2. Claim 14 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over United States Patent No. 5,911,619 to *Uzoh et al.* in view of "Electrochemical Methods" by *Bard et al.*

3. Claims 10 and 19 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over United States Patent No. 5,911,619 to *Uzoh et al.*

ARGUMENTS

A. Claims 1, 2, 5-9, 11-13, and 15-18 are not anticipated by or obvious from *Uzoh et al.*

Claims 1, 2, 5-9, 11-13, and 15-18 stand rejected under 35 U.S.C. § 102(b) as being unpatentable over *Uzoh et al.* on the grounds that *Uzoh et al.* teaches applying a first positive potential between the polishing medium and the electrode for a first time period to remove conductive material from the substrate, wherein the first positive potential is a pulsed potential with a waveform. Appellants respectfully traverse the rejection.

Uzoh et al. does not teach, show, or suggest the first positive potential to be a pulsed potential with a waveform as asserted by the Examiner because *Uzoh et al.* decreases the applied current as the thickness of the layer decreases (see column 4, lines 62-66). Material will be removed immediately upon the start of the process in *Uzoh et al.* Therefore, the first positive potential in *Uzoh et al.* is applied for only an instant in time and the potential would continually decrease as the thickness continually decreases. Because the potential decreases as thickness decreases, the first positive potential of *Uzoh et al.* is not a first potential with a waveform.

The Examiner has stated that "the claims do not specify that each pulse would be exactly the same current as the previous pulse, and such an interpretation cannot be inferred from the claim language under the broadest reasonable interpretation" (see Advisory Action mailed July 6, 2006). Appellants respectfully traverse the Examiner's interpretation of the claims.

Claim 1 specifically recites "applying a first positive potential between the polishing medium and the electrode for a first time period to remove conductive material from the substrate, wherein the first positive potential is a pulsed potential with a waveform". The phrase "a first positive potential" indicates a single value for the potential. The plain meaning of the phrase "a first positive potential" means a positive potential with a single value. If the phrase "a first positive potential" can be broadly

interpreted to mean multiple potentials, then the clause "a second positive potential" has no meaning. The words "first" and "second", by themselves, imply that there is a difference between the two items. When "a first positive potential" is read with "a second positive potential", the reasonable interpretation is that "the first positive potential" is one potential and "a second positive potential" is another potential.

The Examiner's interpretation of the phrase "a first positive potential" to broadly cover varying potentials is not consistent with the language of claim 1. The Examiner's interpretation of the phrase "a first positive potential" to broadly cover different potentials renders the clause "a second positive potential" meaningless.

Additionally, in each situation disclosed in the specification, where a different potential is applied, a different reference numeral is given (see particularly Figures 10-15 and paragraphs [0066] – [0067]) to indicate a different identifier for different potentials. Thus, when interpreting the claims in light of the specification, the Examiner's interpretation is not reasonable.

Therefore, *Uzoh et al.* does not teach, show, or suggest a method of electrochemically and mechanically planarizing a surface of a substrate, comprising (a) providing an electrically conductive solution and an electrode in contact with the electrically conductive solution, (b) disposing a polishing medium in contact with the electrically conductive solution, (c) positioning the substrate having a conductive material formed thereon against the polishing medium so that the surface of the substrate contacts the electrically conductive solution and the polishing medium, (d) applying a first positive potential between the polishing medium and the electrode for a first time period to remove conductive material from the substrate, wherein the first positive potential is a pulsed potential with a waveform, and (e) applying a second positive potential between the polishing medium and the electrode for a second time period to remove conductive material from the substrate, wherein the second potential is lower than the first potential as required by claim 1 and claims dependent thereon.

B. Claim 14 is not obvious over *Uzoh et al.* in view of *Bard et al.*

Claim 14 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over *Uzoh et al.* in view of *Bard et al.* on the grounds that it would have been obvious to select an initial voltage of about 4 volts to 8 volts to control the rate of the electropolishing reaction. Appellants respectfully traverse the rejection.

Bard et al. fails to cure the deficiencies of *Uzoh et al.* *Bard et al.* does not teach, show, or suggest applying a first positive potential between the polishing medium and the electrode for a first time period to remove conductive material from the substrate, wherein the first positive potential is a pulsed potential with a waveform.

Therefore, *Uzoh et al.* in view of *Bard et al.* does not teach, show, or suggest a method of electrochemically and mechanically planarizing a surface of a substrate, comprising (a) providing an electrically conductive solution and an electrode in contact with the electrically conductive solution, (b) disposing a polishing medium in contact with the electrically conductive solution, (c) positioning the substrate having a conductive material formed thereon against the polishing medium so that the surface of the substrate contacts the electrically conductive solution and the polishing medium, (d) applying a first positive potential between the polishing medium and the electrode for a first time period to remove conductive material from the substrate, wherein the first positive potential is a pulsed potential with a waveform, (e) applying a second positive potential between the polishing medium and the electrode for a second time period to remove conductive material from the substrate, wherein the second potential is lower than the first potential, and applying a third positive potential between the polishing medium and the electrode for a third time period, wherein the third positive potential is between about 4 volts and about 8 volts as required by claim 14.

C. Claims 10 and 19 are not obvious over *Uzoh et al.*

Claims 10 and 19 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Uzoh et al.* on grounds that duplication of steps (d) and (e) is obvious. Appellants respectfully traverse the rejection.

Whether or not repeating of steps is obvious, *Uzoh et al.* still does not teach, show or suggest a method of electrochemically and mechanically planarizing a surface

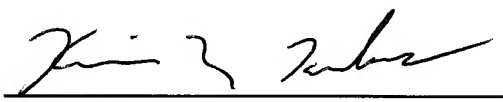
of a substrate, comprising (a) providing an electrically conductive solution and an electrode in contact with the electrically conductive solution, (b) disposing a polishing medium in contact with the electrically conductive solution, (c) positioning the substrate having a conductive material formed thereon against the polishing medium so that the surface of the substrate contacts the electrically conductive solution and the polishing medium, (d) applying a first positive potential between the polishing medium and the electrode for a first time period to remove conductive material from the substrate, wherein the first positive potential is a pulsed potential with a waveform, (e) applying a second positive potential between the polishing medium and the electrode for a second time period to remove conductive material from the substrate, and repeating steps (d) and (e) for a third time period, wherein the second potential is lower than the first potential as required by claim 10.

Additionally, *Uzoh et al.* does not teach, show or suggest a method of electrochemically and mechanically planarizing a surface of a substrate, comprising (a) providing an electrically conductive solution and an electrode in contact with the electrically conductive solution, (b) disposing a polishing medium in contact with the electrically conductive solution, (c) positioning the substrate having a conductive material formed thereon against the polishing medium so that the surface of the substrate contacts the electrically conductive solution and the polishing medium, (d) applying a first positive potential between the polishing medium and the electrode for a first time period to remove conductive material from the substrate, wherein the first positive potential is a pulsed potential with a waveform, (e) applying a second positive potential between the polishing medium and the electrode for a second time period to remove conductive material from the substrate, wherein the second potential is lower than the first potential, (f) applying a third positive or zero potential between the polishing medium and the electrode for a third time period, and repeating steps (d) through (f) for a period of time as required by claim 19.

CONCLUSION

The Examiner errs in finding that claims 1, 2, and 5-19 are obvious. It is respectfully requested that the Examiner's rejection of claim 1, 2, and 5-19 be reversed.

Respectfully submitted,



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CLAIMS APPENDIX

1. (Previously Presented) A method of electrochemically and mechanically planarizing a surface of a substrate, comprising:

(a) providing an electrically conductive solution and an electrode in contact with the electrically conductive solution;

(b) disposing a polishing medium in contact with the electrically conductive solution;

(c) positioning the substrate having a conductive material formed thereon against the polishing medium so that the surface of the substrate contacts the electrically conductive solution and the polishing medium;

(d) applying a first positive potential between the polishing medium and the electrode for a first time period to remove conductive material from the substrate, wherein the first positive potential is a pulsed potential with a waveform; and

(e) applying a second positive potential between the polishing medium and the electrode for a second time period to remove conductive material from the substrate, wherein the second potential is lower than the first potential.

2. (Previously Presented) The method of claim 1, wherein the polishing medium comprises an electrode.

5. (Previously Presented) The method of claim 1, wherein the first positive potential is a pulsed potential with a waveform and the second positive potential is a pulsed potential with a waveform.

6. (Previously Presented) The method of claim 1, further comprising providing relative motion between the substrate and the polishing medium.

7. (Previously Presented) The method of claim 1, wherein the polishing medium comprises a conductive portion, and the conductive portion comprises an electrode.

8. (Previously Presented) The method of claim 1, wherein the first positive potential is modulated within a predefined range of potentials.

9. (Previously Presented) The method of claim 1, wherein the second positive potential is modulated within a predefined range of potentials.

10. (Original) The method of claim 1, further comprising repeating steps (d) and (e) for a third time period.

11. (Previously Presented) The method of claim 1, wherein the polishing medium comprises a conductive polishing material or a composite of a conductive polishing material disposed in a conventional polishing material.

12. (Previously Presented) The method of claim 11, wherein the conductive material comprises copper or tungsten.

13. (Previously Presented) The method of claim 1, further comprising applying a third potential between the polishing medium and the electrode for a third time period, and the third potential is a zero potential.

14. (Previously Presented) The method of claim 16, wherein the third positive potential is between about 4 volts and about 8 volts.

15. (Original) The method of claim 1, wherein the first time period is greater than the second time period.

16. (Previously Presented) The method of claim 1, further comprising applying a third positive potential between the polishing medium and the electrode for a third time period.

17. (Previously Presented) The method of claim 16, wherein the third positive potential is a pulsed potential with a waveform.

18. (Previously Presented) The method of claim 16, wherein the first positive potential is a pulsed potential with a waveform, the second positive potential is a pulsed potential with a waveform, and the third positive potential is a pulsed potential with a waveform.

19. (Previously Presented) The method of claim 1, further comprising

(f) applying a third positive or zero potential between the polishing medium and the electrode for a third time period; and

repeating steps (d) through (f) for a period of time.

EVIDENCE APPENDIX

NONE

RELATED PROCEEDINGS APPENDIX

NONE